# Developer Guide

**jWebSocket**

**JMXPlugIn**

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**1.0**

1. **Overview**

The main objective of this project is to provide a management solution using JMX (Java Management Extensions) technology for the jWebSocket framework. For this, the JMXPlugIn module was developed which guarantees remote management of the applications developed using this framework through the RMI and HTTP protocols. To achieve it, this module uses the JMX integration provided by Spring framework, specifically modifying the class export mechanism for coupling it to the characteristics of jWebSocket.

1. **Infrastructure, Model, Approach**

The JMXPlugIn module is based on the native technology in Java, JMX. Therefore, this module implements the architecture specified for this technology, which is designed for building highly scalable management solutions. The JMX architecture is divided into three main layers: Instrumentation, Agent and Distributed Services.

In keeping with the JMX architecture, the JMXPlugIn has an Instrumentation layer which contains the components responsible for encapsulating the objects to be managed, i.e. contains the called MBeans or manageable objects. Moreover, the module presents an Agent layer that contains all the components for controlling the MBeans belonging to the Instrumentation layer and makes them available for remote access. This is the main layer of the module, which allows creating the JMX infrastructure for the jWebSocket server. Finally, the Distributed Services layer contains the elements that enable remote access to the functionality of the module. In this specific case, the access is via the RMI connector or HTTP adapter. This layer is also responsible for the security in the module. Importantly, this layer as well contains the JMX-compatible client applications, which are used to access the module. However, these are not part of the implementation, which are not reflected in the JMXPlugIn infrastructure.

**Used Design Patterns**

Among the design patterns used in the JMXPlugIn module the Observer pattern needs to be mentioned, which allows you to configure and manage the event notification mechanism of the JMX technology. Moreover the Facade pattern was used in order to establish a common interface to allow communication between plug-ins thus enabling remotely invokes its functionality.

**TokenPlugIn or EventPlugIn**

The JMXPlugIn module was developed based on the TokenPlugIn since it is a low-level structure, which provides improved performance for applications with few features and whose message exchange infrastructure is easier.

**Communication Between Plugins**

One of the features provided by this module is to invoke functions of the applications that are running on a certain jWebSocket server remotely. To achieve this it was necessary to create a common interface to allow internal communication between plug-ins. Thus the JMXPlugIn is able to interact with those plug-ins that implement this communication mechanism.

1. **Requirement and Prerequisites**

The requirements for the continued development of the JMXPlugIn module are:

* Network connection
* Using Spring framework specifically JMX integration present therein.

1. **Modules, Structure**

The main aspects that describe the organizational structure of the module JMXPlugIn is reflected in the following table:

|  |  |
| --- | --- |
| Project Name: | JMXPlugIn |
| Location of the sources in the SVN server: | <https://jwsdev.org:9443/svn/jWebSocket/branches/jWebSocket-1.0/jWebSocketPlugIns/jWebSocketJMXPlugIn> |
| SVN branch: | jWebSocket-1.0 |
| Maven dependencies: | <dependency>  <groupId>org.jwebsocket</groupId>  <artifactId>jWebSocketCommon</artifactId>  <version>1.0</version>  </dependency>  <dependency>  <groupId>org.jwebsocket</groupId>  <artifactId>jWebSocketServerAPI</artifactId>  <version>1.0</version>  </dependency>  <dependency>  <groupId>org.jwebsocket</groupId>  <artifactId>jWebSocketServer</artifactId>  <version>1.0</version>  </dependency>    <dependency>  <groupId>mx4j</groupId>  <artifactId>mx4j-tools</artifactId>  <version>2.1.1</version>  </dependency> |
| JAR module: | jWebSocketJMXPlugIn-1.0.jar |
| Package structure: | NameSpace: org.jwebsocket.plugins.jmx |
| org.jwebsocket.plugins.jmx:  Contains the core classes of the module that allows the creation of the JMX infrastructure for jWebSocket framework. | |
| org.jwebsocket.plugins.jmx.configdefinition:  Contains the definition of the configuration file used to integrate the plug-ins and classes that will be exported via JMX. | |
| org.jwebsocket.plugins.jmx.mbeanspring:  Contains the classes that allow engaging the class export mechanism used in Spring to jWebSocket. | |
| org.jwebsocket. plugins.jmx.util:  It contains the generic libraries with utility functions used in the module. | |

**4.1 Code Structure**

The structure of the developed module source code matches the picture shown below:

**Elements Description:**

src: This directory contains all the source code of the classes and libraries of the solution.

target: This directory temporarily stores the compiled source code, its content is not included in the version control.

nbactions.xml: Project configuration file created by the NetBeans IDE. The content of this file is not included in the version control.

pom.xml: Configuration file that contains information about the project and details of the settings used by Maven to build the project.

The JMXPlugIn module uses an external library called MX4J. In order to reduce the external dependencies and provide a complete solution in a single .jar, we bundle this library using the one-jar plug-in of Maven. The following image shows the location of one-jar.xml configuration file:

one-jar.xml: contains the configuration of the one-jar plug-in of Maven to create a complete solution of the JMXPlugIn module in a single .jar.

**4.2 Package Description**

The JMXPlugIn module is structured into 4 packages. Among these is the org.jwebsokcket.plugins.jmx package which contains the following classes:

|  |  |
| --- | --- |
| **Class** | **Description** |
| JMXPlugIn | Main class of the module which is responsible for creating the JMX infrastructure to use and initialize all other components within the module. |
| JMXPlugInFunctions | Class that allows to invoke certain features of the plug-ins that are running on a given server. It also provides information about the plug-ins that are loaded and the functions that can be invoked. |
| JMXServerFunctions | Class that allows to manage certain functions of jWebSocket server. |
| JMXPlugInsExporter | Main class of the mechanism for integrating plug-ins and classes to the JMX infrastructure of the module. This class is responsible for reading all the configuration files created for this purpose and register the object so they can be remotely exported. |

The org.jwebsokcket.plugins.jmx.configdefinition package contains the following classes:

|  |  |
| --- | --- |
| **Class** | **Description** |
| AttributeDefinition | Class that allows to define the attributes of the plug-ins or classes to export and their metadata. |
| ConstructorDefinition | Class that allows to define the constructors of the classes to export and their metadata |
| ConstuctorParameterDefinition | Class that allows to define the input parameters of the constructors of the classes to export and their metadata |
| FeatureDefinition | Generic class that allows to define the name and description of all elements of the plug-ins or classes to export. |
| JMXDefinition | Main class that contains all the elements necessary to form the class or plug-in object to export and its metadata. |
| JMXDefinitionException | Class that allows to define an exception associated with a plug-in or class that will be exported. Thus if an exception is thrown when trying to create a plug-in or class will be show an object of this type. |
| JMXPluginDefinition | Class that contains the specific elements to create the plug-in object to export. |
| NotificationDefinition | Class that allows to define the event notifications of the plug-ins and classes to export and their metadata. For the module the following events have been defined for notifications: before and after performing an operation and when you change the value of an attribute. |
| OperationDefinition | Class that allows to define the operations of the plug-ins and classes to export and their metadata. |
| ParameterDefinition | Class that allows defines the input parameters of the operations of the plug-ins and classes to export and their metadata. |

The org.jwebsokcket.plugins.jmx.mbeanspring package contains the following clases:

|  |  |
| --- | --- |
| **Class** | **Description** |
| MBeanEnabledExporter | Class that redefines certain functios of the Spring MBeanExporter class, taking into account the characteristics of the JMXPlugIn module. |
| ModelMBeanExtension | Class that implements a ModelMBean class specific to the module to develop. |
| ModelMBeanUtil | Class that contains the auxiliary methods for the ModelMBean creation. |
| NotificationInfoMap | Class that define an event notification map that will be created for a certain ModelMBean. |

The org.jwebsokcket.plugins.jmx.util package contains the following classes:

|  |  |
| --- | --- |
| **Class** | **Description** |
| JMXHandler | Class that dynamically converts the data type Map, largely driven by jWebSocket framework, to the CompositeData data type, which is used by the JMX technology for working with complex data types like objects, since for default this technology is only able to handle simple data types. |
| JMXPlugInAuthenticator | Class that implements the security mechanism for remote access to the module via the RMI protocol. |

1. **Source Code**

**5.1 Common Code Standards**

The common code standards used to develop the JMXPlugIn module are the same defined to jWebSocket framework.

**5.2 Reusable Components**

The module architecture is divided into separate components which ensure its reuse in applications with similar characteristics. The components belonging to this module which can be reused are:

* **JMXHandler:** Class that dynamically converts the data type Map, largely driven by jWebSocket framework, to the CompositeData data type, which is used by the JMX technology for working with complex data types like objects, since for default this technology is only able to handle simple data types.
* **JMXPlugInExporter:** allows you to modify the default behavior of the JMX technology support provided by Spring. This component allows the jWebSocket framework has a greater control and personalization to display information about the classes or plug-ins to be exported using JMX technology. This avoids the use of interfaces or Java annotations, Spring default mechanisms that limit the work with exported class.

1. **Interfaces**

To access the JMXPlugIn module it is possible to use JMX-compatible client applications. However, only as far as the implementations of these applications are not part of the scope of this project.

1. **Frameworks, Libraries and Tools**

To develop the JMXPlugIn module the Spring framework was used which has the Apache License 2.0[[1]](#footnote-1) license. This framework has integration with JMX technology which is used mostly for developing JMXPlugIn. Given that currently jWebSocket integrates the IoC Container of Spring as well as Authentication and Validation module, is not needed any additional configuration. For more information on the Spring framework visit the following link: <http://www.springsource.org/>.

Moreover, the JMXPlugIn module uses the MX4J library which holds the Apache-style[[2]](#footnote-2) license. This library is used for the remote access via HTTP protocol. For more information about the MX4J library visit the following link: <http://mx4j.sourceforge.net/>.

1. **Database and Persistence**

The JMXPlugIn module does not require the use of a database for its operation.

1. **Hardware**

The JMXPlugIn module does not require the use of any special additional hardware for its operation.

1. **Security**

In order to ensure the safety of the JMXPlugIn module was implemented an authentication component which uses MD5 encryption algorithm and in turn establishes communication over SSL for each of the protocols used for remote access, i.e. HTTP and RMI protocols.

1. <http://www.apache.org/licenses/LICENSE-2.0.html> [↑](#footnote-ref-1)
2. <http://mx4j.sourceforge.net/docs/ch01s06.html> [↑](#footnote-ref-2)